MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

TCS 2241 – COMPUTATIONAL SCIENCE

(All sections / Groups)

7 MARCH 2020
2:30 p.m – 4:30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 6 pages (excluding cover page) with 5 Questions and Appendix of statistical table.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided

Question 1

(a) CountFast produces a handheld calculator and a scientific calculator. Long-term projections indicate an expected demand of at least 150 scientific and 100 handheld calculators each day. Because of limitations on production capacity, no more than 250 scientific and 200 handheld calculators can be made daily. To satisfy a shipping contract, a minimum of 250 calculators must be shipped each day. If each scientific calculator sold, results in a RM 20 loss, but each handheld calculator produces a RM 50 profit. Formulate a Linear Programming model for this problem. Define the decision variables, objective function and all the constraints that fulfill this problem.

[2.5 marks]

(b) Consider the following Linear Programming problem. Answer the following questions.

Maximize $Z = 3x_1 + 2x_2$

Subject to $2x_1 + x_2 \leq 100$
$x_1 + x_2 \leq 80$
$x_1 \leq 40$
$x_1, x_2 \geq 0$

(i) Express the problem in a standard equation format with slack variables (S_1, S_2, S_3).

[2.5 marks]

(ii) Complete the following table of algebraic method to solve the above b(i) problem.

[2 marks]

Non Basic variables	Basic variables	Basic solution	Z
(x_1, x_2)	(S_1, S_2, S_3)	(0, 0, 0)	0
(S_1, x_2)	(x_1, S_2, S_3)	**BS1 = ?**	-
(S_2, x_2)	(x_1, S_1, S_3)	(80, -60, -40)	-
(S_3, x_2)	(x_1, S_1, S_2)	**BS2 = ?**	80
(x_1, S_1)	(x_2, S_2, S_3)	(100, -20, 40)	-
(x_1, S_2)	(x_2, S_1, S_3)	(80, 20, 40)	160
(x_1, S_3)	(x_2, S_1, S_2)	-	-
(S_1, S_2)	(x_1, x_2, S_3)	**BS3 = ?**	180
(S_1, S_3)	(x_1, x_2, S_2)	(40, 20, 20)	160
(S_2, S_3)	(x_1, x_2, S_1)	**BS4 = ?**	-

(iii) Use graphical method to show the feasible region and corner points. Identify the basic solutions from table (ii) that correspond to the corner points in the graph.

[3 marks]

Continued .....

Question 2

(a) The Big-M method introduces surplus and artificial variables to convert all constraints that contain "≥" and "=". Consider the following Linear Programming problem expressed in standard format. Answer the following questions.

Minimize $Z - 3x_1 - x_2 + 0S1 + 0S2 - MA1 - MA2 = 0$

Subject to

$4x_1 + x_2 + A1 = 4$

$5x_1 + 3x_2 - S1 + A2 = 7$

$3x_1 + 2x_2 + S2 = 6$

$x_1, x_2, S1, S2, A1, A2 \geq 0$

(i) Create the initial table for the above problem.

[3 marks]

(ii) Based on the initial table from (i), there are non-zero values (-*M*) in the Z-row. To correct this violation, prepare a new initial table for Big-M method.

[2 marks]

(iii) After correction, identify the entering and leaving variables from table (ii).

[2 marks]

(b) The following Linear Programming problem is having **unbounded** solutions. Show with simplex table and explain.

[3 marks]

Maximize $Z = 73x_1 + 100x_2$

Subject to $13x_1 - 25x_2 \leq 60$

$49x_1 - 21x_2 \leq 280$

$-4x_2 \leq 70$

$x_1, x_2 \geq 0$

Continued .....

Question 3

(a) Use Vogel Approximation method to find the initial basic feasible solution.

[4 marks]

From	To			Supply
	Customer 1	Customer 2	Customer 3	
Warehouse 1	2	7	4	**5**
Warehouse 2	3	3	1	**8**
Warehouse 2	5	4	7	**7**
Warehouse 2	1	6	2	**14**
Demand	**7**	**9**	**18**	

(b) The following table is part of the solution in solving a transportation problem with the indicated basic variables (25, 25, 40, 10). Complete the table: **(i), (ii), (iii) and (iv).**

[2 marks]

	v_1=15	**v_2= (i)**	**v_2=25**	
u_1 =0	15 ***25***	30 ***25***	20 **(iii)**	50
u_2 = (ii)	30 **(iv)**	40 ***40***	35 ***10***	30
	25	45	10	

(c) A building firm possesses four cranes, each of which has a distance (km) from four different construction sites as shown in the following table. Use Hungarian method to minimize the cost of assigning the crane to different construction sites.

[4 marks]

Crane	**Site 1**	**Site 2**	**Site 3**	**Site 4**
E	90	75	75	80
F	35	85	55	65
G	125	95	90	105
H	45	110	95	115

Continued .....

Question 4

Consider a small project that involves the following activities.

Activity	Preceding Activity	Completion Times (days)		
		Optimistic	Most Likely	Pessimistic
A	-	5	6	7
B	-	4	5	18
C	A	4	15	20
D	B,C	3	4	5
E	A	5	16	18

(a) Calculate the expected value, $E(D_{ij})$ and the variance $var(D_{ij})$ of the completion time for each activity.

[2 marks]

(b) Illustrate the project network diagram and determine the earliest and latest event times for each of the activity.

[3 marks]

(c) Find out the critical path. Compute the mean and variance of the critical path.

[2 marks]

(d) Assuming that the normal distribution applies, determine the probability that the critical path will take between 18 and 26 days to complete.

[3 marks]

Continued .....

Question 5

(a) The demand for spring water at the Tesco is 600 litres per week. The setup cost for placing an order to replenish inventory is RM25. The order is delivered by the supplier from the Ozark mountains to Tesco. The water loses its freshness while stored at the Tesco. To account for this, the Tesco charges an annual holding cost of RM 2.60/ liter. Note that 1 year has approximately 52 weeks. Determine how often the Tesco should order for water and what size each order should be. State the inventory policy.

[3 marks]

(b) In the aspect of non-linear programming problem, Karush-Kuhn-Tucker (KKT) method is suitable for inequality ($\leq$, $\geq$) constraint. Given the following KKT conditions for a **maximization** problem, find the optimal solution.

[7 marks]

$$\frac{\partial f}{\partial x_j} - \lambda \frac{\partial h}{\partial x_j} = 0$$

$$\lambda h(x) = 0$$

$$h(x) \leq 0$$

$$\lambda \geq 0$$

$$f = 4x_1 - x_1^2 + 8x_2 - x_2^2$$

$$h = x_1 + x_2 - 2$$

Continued .....

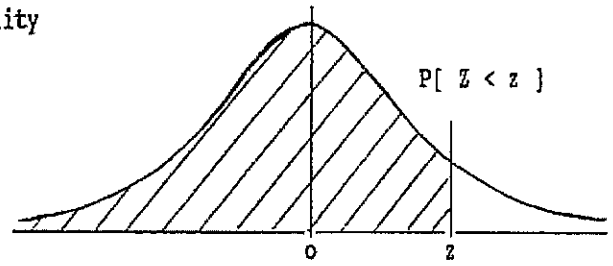
Appendix:

STANDARD STATISTICAL TABLES

1. Areas under the Normal Distribution

The table gives the cumulative probability up to the standardised normal value z

i.e. $$P[\ Z < z\ ] = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} \exp(-\tfrac{1}{2}Z^2)\ dZ$$



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5159	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7854
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8804	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9773	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9865	0.9868	0.9871	0.9874	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9924	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9980	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
z	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
P	0.9986	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000

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